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# Aquifer Analysis and Properties Formulas

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# List of 27 Aquifer Analysis and Properties Formulas

## Aquifer Analysis and Properties

### Analysis of Aquifer-Test Data

#### 1) Elevation Head using Total Head

Open Calculator

fx $z = H_t - h_p$

ex $38.2\text{mm} = 12.02\text{cm} - 82\text{mm}$

#### 2) Pressure Head for given Total Head

Open Calculator

fx $h_p = H_t - z$

ex $82.2\text{mm} = 12.02\text{cm} - 38\text{mm}$

#### 3) Storage Coefficient from Theis Equation of Transmissivity

Open Calculator

fx $S = \frac{Q \cdot W_u}{T \cdot 4 \cdot \pi}$

ex $0.10128 = \frac{7\text{m}^3/\text{s} \cdot 2}{11\text{m}^2/\text{s} \cdot 4 \cdot \pi}$

## 4) Theis Equation to determine Storage Coefficient

Open Calculator

fx $$S' = \frac{4 \cdot T \cdot t \cdot u}{r^2}$$

ex $$16.05333 = \frac{4 \cdot 11\text{m}^2/\text{s} \cdot 4\text{s} \cdot 0.81}{(2.98\text{m})^2}$$

## 5) Theis equation to determine transmissivity

Open Calculator

fx $$T = \frac{Q \cdot W_u}{4 \cdot \pi \cdot S}$$

ex $$11.03054\text{m}^2/\text{s} = \frac{7\text{m}^3/\text{s} \cdot 2}{4 \cdot \pi \cdot 0.101}$$

## 6) Total Head

Open Calculator

fx $$H_t = z + h_p$$

ex $$12\text{cm} = 38\text{mm} + 82\text{mm}$$

## 7) Transmissivity given Storage Coefficient from Theis Equation

Open Calculator

fx $$T = \frac{S' \cdot r^2}{4 \cdot t \cdot u}$$

ex $$10.99772\text{m}^2/\text{s} = \frac{16.05 \cdot (2.98\text{m})^2}{4 \cdot 4\text{s} \cdot 0.81}$$

# Aquifer Properties

## Compressibility of Aquifers

### 8) Barometric Efficiency given Compressibility Parameters

Open Calculator

fx $$BE = \left(\frac{\eta \cdot \beta}{\alpha} + \eta \cdot \beta\right)$$

ex $$2.32 = \left(\frac{0.32 \cdot 4.35}{1.5} + 0.32 \cdot 4.35\right)$$

### 9) Coefficient of Storage for Unconfined Aquifer

Open Calculator

fx $$S'' = S_y + \left(\frac{\gamma}{1000}\right) \cdot (\alpha + \eta \cdot \beta) \cdot B_s$$

ex $$85.28553 = 0.2 + \left(\frac{9.807 kN/m^3}{1000}\right) \cdot (1.5 + 0.32 \cdot 4.35) \cdot 3$$

### 10) Discharge per Unit Width of Aquifer

Open Calculator

fx $$q = (h_o - h_1) \cdot K' \cdot \frac{b}{L}$$

ex $$0.134615 m^3/s = (12m - 5m) \cdot 0.5cm/s \cdot \frac{15.0m}{3.9m}$$

## 11) Saturated Thickness of Aquifer when Coefficient of Storage for Unconfined Aquifer is Considered

Open Calculator

fx $$B_s = \frac{S'' - S_y}{\left(\frac{\gamma}{1000}\right) \cdot (\alpha + \eta \cdot \beta)}$$

ex $$2.989933 = \frac{85 - 0.2}{\left(\frac{9.807 \text{kN/m}^3}{1000}\right) \cdot (1.5 + 0.32 \cdot 4.35)}$$

## Darcy's Law

## 12) Apparent Velocity and Bulk Pore Velocity Relationship

Open Calculator

fx $$V = V_a \cdot \eta$$

ex $$24\text{m/s} = 75\text{m/s} \cdot 0.32$$

## 13) Apparent Velocity of Seepage

Open Calculator

fx $$V = K'' \cdot \text{dhds}$$

ex $$24\text{m/s} = 10\text{m/s} \cdot 2.4$$

## 14) Apparent Velocity of Seepage given Reynolds Number of Value Unity

Open Calculator

fx $$V = \frac{Re \cdot \nu_{stokes}}{d_a}$$

ex $$24.00662\text{m/s} = \frac{5000 \cdot 7.25\text{St}}{0.151\text{m}}$$

## 15) Apparent Velocity of Seepage when Discharge and Cross-Sectional Area are considered

Open Calculator

fx $$V = \frac{Q'}{A}$$

ex $$24\text{m/s} = \frac{3.0\text{m}^3\text{/s}}{0.125\text{m}^2}$$

## 16) Bulk Pore Velocity

Open Calculator

fx $$V_a = \frac{V}{\eta}$$

ex $$74.96875\text{m/s} = \frac{23.99\text{m/s}}{0.32}$$

## 17) Coefficient of Permeability when Apparent Velocity of Seepage is considered

Open Calculator

$$K'' = \frac{V}{dhds}$$

$$9.995833\text{m/s} = \frac{23.99\text{m/s}}{2.4}$$

## 18) Darcy's Law

Open Calculator

$$q_{flow} = K \cdot A_{cs} \cdot dhds$$

$$24.024\text{m}^3/\text{s} = .77\text{m/s} \cdot 13\text{m}^2 \cdot 2.4$$

## 19) Hydraulic Gradient when Apparent Velocity of Seepage is considered

Open Calculator

$$dhds = \frac{V}{K''}$$

$$2.399 = \frac{23.99\text{m/s}}{10\text{m/s}}$$

## 20) Kinematic Viscosity of Water given Reynolds Number of Value Unity

Open Calculator

$$\nu_{stokes} = \frac{V \cdot d_a}{Re}$$

$$7.24498\text{St} = \frac{23.99\text{m/s} \cdot 0.151\text{m}}{5000}$$

## 21) Representative Particle Size given Reynolds Number of Value Unity

Open Calculator

$$d_a = \frac{Re \cdot \upsilon}{V}$$

$$0.20842\text{m} = \frac{5000 \cdot 0.001\text{m}^2/\text{s}}{23.99\text{m/s}}$$

## 22) Reynolds Number of Value Unity

Open Calculator

$$Re = \frac{V \cdot d_a}{\nu_{stokes}}$$

$$4996.538 = \frac{23.99\text{m/s} \cdot 0.151\text{m}}{7.25\text{St}}$$

# Porosity

## 23) Porosity

Open Calculator

$$\eta = \frac{V_t - V_s}{V_t}$$

$$0.321267 = \frac{22.1\text{m}^3 - 15\text{m}^3}{22.1\text{m}^3}$$

## 24) Porosity given Bulk Pore Velocity

Open Calculator

fx $$\eta = \frac{V}{V_a}$$

ex $$0.319867 = \frac{23.99\text{m/s}}{75\text{m/s}}$$

## 25) Porosity given Specific Yield and Specific Retention

Open Calculator

fx $$\eta = S_y + S_r$$

ex $$0.35 = 0.2 + 0.15$$

## 26) Total Volume of Soil or Rock Sample given Porosity

Open Calculator

fx $$V_t = \left(\frac{V_v}{\eta_v}\right) \cdot 100$$

ex $$22.4\text{m}^3 = \left(\frac{5.6\text{m}^3}{25}\right) \cdot 100$$

## 27) Volume of Solids given Porosity

Open Calculator

fx $$V_s = (V_t \cdot (1 - \eta))$$

ex $$15.028\text{m}^3 = (22.1\text{m}^3 \cdot (1 - 0.32))$$

# Variables Used

- **A** Cross Section Area of Porous Medium *(Square Meter)*
- **$A_{cs}$** Cross Sectional Area *(Square Meter)*
- **b** Aquifer Thickness *(Meter)*
- **$B_s$** Saturated Thickness of Aquifer
- **BE** Barometric Efficiency
- **$d_a$** Representative Particle Size *(Meter)*
- **dhds** Hydraulic Gradient
- **$h_1$** Piezometric Head at Downstream End *(Meter)*
- **$h_o$** Piezometric Head at Upstream End *(Meter)*
- **$h_p$** Pressure Head *(Millimeter)*
- **$H_t$** Total Head *(Centimeter)*
- **K** Hydraulic Conductivity *(Meter per Second)*
- **K'** Permeability Coefficient *(Centimeter per Second)*
- **K''** Coefficient of Permeability *(Meter per Second)*
- **L** Length of Permeameter *(Meter)*
- **q** Discharge per Unit Width of Aquifer *(Cubic Meter per Second)*
- **Q** Pumping Rate *(Cubic Meter per Second)*
- **Q'** Discharge *(Cubic Meter per Second)*
- **$q_{flow}$** Flow Rate *(Cubic Meter per Second)*
- **r** Distance from Pumping Well *(Meter)*
- **Re** Reynolds Number
- **S** Storage Coefficient (Theis Equation)
- **S'** Storage Coefficient

- **S''** Coefficient of Storage for Unconfined Aquifer
- $S_r$ Specific Retention
- $S_y$ Specific Yield
- **t** Pumping Time *(Second)*
- **T** Transmissivity *(Square Meter per Second)*
- **u** Varying Dimensionless Group
- **V** Apparent Velocity of Seepage *(Meter per Second)*
- $V_a$ Bulk Pore Velocity *(Meter per Second)*
- $V_s$ Volume of Solids *(Cubic Meter)*
- $V_t$ Total Volume of Soil or Rock Sample *(Cubic Meter)*
- $V_v$ Volume of Voids *(Cubic Meter)*
- $W_u$ Well Function of U
- **z** Elevation Head *(Millimeter)*
- **α** Compressibility
- **β** Compressibility of Water
- **γ** Unit Weight of Fluid *(Kilonewton per Cubic Meter)*
- **η** Porosity of Soil
- $\eta_v$ Volume Percent of Porosity
- $v_{stokes}$ Kinematic Viscosity in Stokes *(Stokes)*
- **υ** Kinematic Viscosity *(Square Meter per Second)*

# Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  *Archimedes' constant*
- Measurement: **Length** in Millimeter (mm), Centimeter (cm), Meter (m)
  *Length Unit Conversion*
- Measurement: **Time** in Second (s)
  *Time Unit Conversion*
- Measurement: **Volume** in Cubic Meter ($m^3$)
  *Volume Unit Conversion*
- Measurement: **Area** in Square Meter ($m^2$)
  *Area Unit Conversion*
- Measurement: **Speed** in Centimeter per Second (cm/s), Meter per Second (m/s)
  *Speed Unit Conversion*
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second ($m^3/s$)
  *Volumetric Flow Rate Unit Conversion*
- Measurement: **Kinematic Viscosity** in Square Meter per Second ($m^2/s$), Stokes (St)
  *Kinematic Viscosity Unit Conversion*
- Measurement: **Specific Weight** in Kilonewton per Cubic Meter ($kN/m^3$)
  *Specific Weight Unit Conversion*

## Check other formula lists

- **Aquifer Analysis and Properties Formulas**
- **Coefficient of Permeability Formulas**
- **Distance-Drawdown Analysis Formulas**
- **Steady Flow into a Well Formulas**

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